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(54) THIN FILM CAPACITOR

(57) Abstract:

PURPOSE: To obtain a small-sized high capacity thin film capacitor by forming a metal body on a thin inorganic dielectric deposited on a metal foil.

CONSTITUTION: The thin film capacitor comprises a thin inorganic dielectric 2 deposited on a metal foil 1 serving as a substrate and a lower electrode, and an upper electrode, i.e., a metal body 3, formed on the thin inorganic dielectric 2. When the thin film capacitor is produced, a thin inorganic dielectric of $(Ba_{0.5}, Sr_{0.5})TiO_3$ is deposited, as a mask, on the metal foil, i.e., a Pt foil 1, using an-RF magnetron sputtering system. A thin mask of Ni 3 is then deposited, as the metal body 3, on the thin inorganic dielectric 2 using an RF magnetron. Since the total thickness of an element is decreased, the thin inorganic dielectrics and the metal bodies can be laminated in multilayer thus realizing a small-sized high capacity thin film capacitor.

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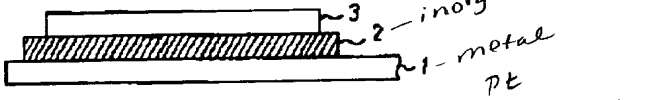

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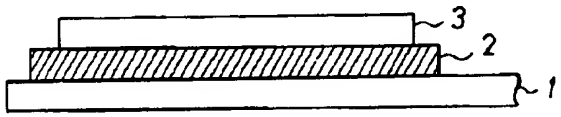
(54)【発明の名称】　薄膜キャパシタ

(57)【要約】
【目的】プロセスを複雑にすること無く小型・大容量の薄膜キャパシタを提供することを目的とする。
【構成】金属箔体１と、金属箔体１上に成膜された無機誘電体薄膜２と、この無機誘電体薄膜２上に形成された金属体３とを具備することを特徴とする薄膜キャパシタ。



（実施例1）図1は本発明の薄膜キャパシタの概略構成を示す断面図である。基板と下部電極を兼ねている金属箔体1上に成膜形成された無機誘電体薄膜2、この無機誘電体薄膜2上に上部電極である金属体3が形成されている。

【0014】次に本実施例による薄膜キャパシタの製造方法を示す。先ず金属箔体1として厚さ10μmのPt箔1を用意し、このPt箔1上に、RFマグネトロンスパッタリング装置（（株）芝浦製作所製：CFS－8EP－55SC）を用いて、$(Ba_{0.5}Sr_{0.5})TiO_3$、無機誘電体薄膜2を200nmマスク成膜する。この時の成膜温度は500℃とした。

【0015】次にこの無機誘電体薄膜2上に、RFマグネトロンスパッタリング装置により、成膜温度350℃で金属体3としてNi薄膜3を100nmマスク成膜する。上部電極のサイズは1mm角とした。

【0016】こうして得られた薄膜キャパシタの誘電特性を測定したところ、キャパシタサイズ1mm×1mm×10μmtに対し、静電容量C＝30nFの値が得られ良好な特性が得られた。

【0017】このキャパシタは、例えば0．6mm厚の熱酸化膜付きSiウエハ上に作成されたキャパシタに比べて、約60分の1の薄膜化が達成されている。さらにこのキャパシタをマザーボード上に実装する際に、下部電極の導通は金属箔基板の下面を導電性ペーストにより接着することで得られるので、ワイヤボンディングで実装する場合にもボンディングパッドが1つ（上部電極用）だけでよい。従って周辺に要するスペースが半減するため高密度実装に適している。従って本実施例では素子の小型化に充分な大きさで充分な静電容量を得ることができる。

【0018】（実施例2）表面仕上げ状態の異なる4種類の金属箔体1であるPt箔1（10μm厚、表面粗さRa＝1nm、5nm、10nm、20nm）上に、RFマグネトロンスパッタリング装置を用いて、無機誘電体薄膜2として$SrTiO_3$薄膜2（膜厚100nm、成膜温度500℃）、金属体3としてNi薄膜3（膜厚100nm、成膜温度350℃）を順次マスクを用いて成膜した。素子のサイズは約1mm角とした。

【0019】こうして得られた薄膜キャパシタの誘電特性を測定したところ、$SrTiO_3$膜厚tがPt箔のRaに対し、t≧20×Raの関係を満たす場合に、リーク電流密度］≦10^{-5}A／cm^2、破壊電圧Vmax.≧20Vの実用的な値が得られた。

【0020】本実施例においても素子の小型化に充分な大きさで充分な静電容量を得ることができる。

（実施例3）先ず金属箔体1として厚さ5μmのAl箔1を用意し、このAl箔1上に、RFマグネトロンスパッタリング装置を用いて、無機誘電体薄膜2として$SrTiO_3$薄膜2（膜厚100nm、成膜温度400℃）

を1mm×100mmの帯状のマスクにより成膜した。

【0021】次にこの無機誘電体薄膜2上に、上記マスクを用いてRFマグネトロンスパッタリング装置により、金属体3としてNi薄膜3（膜厚100nm、成膜温度350℃）を成膜した。次にNi箔1及びNi薄膜3にPtの引き出し線（図示せず）を溶接し、$SrTiO_3$薄膜2及びNi薄膜3が積層されたNi箔1を帯の短辺（1mm長）を軸として巻き込んだところ、直径約1mm、長さ1mmの円柱状の薄膜キャパシタが完成した。

【0022】こうして得られた薄膜キャパシタの誘電特性を測定したところ、キャパシタサイズ1mmφ×1mmに対し、静電容量C＝4．4μFの大容量値が得られた。このキャパシタは通常の有機フィルムコンデンサと同様な巻き込み型が有機誘電体より比誘電率が2オーダ大きな無機高誘電率薄膜により実現しているので、同じ容量の有機フィルムコンデンサに比してキャパシタサイズを2オーダ小さくできる。従って本実施例では素子の小型化に充分な大きさで充分な静電容量を得ることができる。

【0023】（実施例4）先ず金属箔体1として厚さ5μmのNi箔1を用意し、このNi箔1上に、RFマグネトロンスパッタリング装置を用いて、無機誘電体薄膜2として$SrTiO_3$薄膜2（膜厚100nm、成膜温度400℃）を1mm×50mmの帯状のマスクにより成膜した。

【0024】次にこの無機誘電体薄膜2上に、上記マスクを用いてRFマグネトロンスパッタリング装置により、金属体3としてNi薄膜3（膜厚100nm、成膜温度350℃）を成膜した。次にNi箔1及びNi薄膜3にPtの引き出し線（図示せず）を溶接し、$SrTiO_3$薄膜2及びNi薄膜3が積層されたNi箔1を帯の短辺（1mm長）を軸として長辺方向を1mm幅につづら折りにしたところ、幅1mm、長さ1mm、厚さ約1mmの薄膜キャパシタが完成した。

【0025】こうして得られた薄膜キャパシタの誘電特性を測定したところ、キャパシタサイズ1mm×1mm×1mmに対し、静電容量C＝1．1μFの大容量値が得られた。本実施例においても実施例3と同様な理由により、素子の小型化に充分な大きさで充分な静電容量を得ることができる。

【0026】（実施例5）図2（a）、（b）、（c）は本実施例に係る薄膜キャパシタの製造工程を説明する断面図である。

【0027】先ず図2（a）に示すように、金属箔体4として厚さ5μmのPt箔4を用意し、このPt箔4上に、RFマグネトロンスパッタリング装置を用いて、無機誘電体薄膜5として$(Ba_{0.5}Sr_{0.5})TiO_3$薄膜5（膜厚200nm、成膜温度500℃）及び金属体6としてPt薄膜6（膜厚50nm、成膜温度400

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℃）をそれぞれ無機誘電体薄膜５を４層、金属体６を３層、計７層を順次成膜した。その際、（$Ba_{0.5}Sr_{0.5}$）TiO_3薄膜５が図中に示すように互い違いに接触するようにＰｔ薄膜６をマスク成膜した。

【００２８】次に図２（ｂ）に示すように、ＰＥＰ工程、イオンミリング工程、レジスト剥離工程により、（$Ba_{0.5}Sr_{0.5}$）TiO_3薄膜５及びＰｔ薄膜６の両側を一括テーパーエッチングした。その際、図中に示すように無機誘電体薄膜層５の最下層の片側が残るように、エッチング途中にＰＥＰ工程を挟んで行った。

【００２９】次に図２（ｃ）に示すように、Ｎｉ電極層７ａ及び７ｂを形成した。その結果、Ｎｉ電極７ａとＰｔ電極層６ａとＰｔ箔４とが電気的に接触し、Ｎｉ電極層７ａとＰｔ電極６ｂとが電気的に接触した構造となり、無機誘電体層５を介して電極層が重なっている部分（図中Ｌ）が多層のキャパシタの構成となる。

【００３０】こうして得られた薄膜キャパシタの誘電特性を測定したところ、キャパシタサイズ１ｍｍ×１ｍｍ×６μｍｔに対し、静電容量Ｃ＝１２０ｎＦの値が得られた。

【００３１】このキャパシタは通常の例えば０．６ｍｍ厚熱酸化膜付きＳｉ上に作成した同構造のキャパシタに比べて、約１００分の１の薄膜化が達成されている。従って本実施例では素子の小型化に充分な大きさで充分な静電容量を得ることができる。

【００３２】（実施例６）図３は本発明の薄膜キャパシタを使用した移動体通信端末のパワーアンプモジュールの一部を示す断面図であり、図中８はAl_2O_3基板、９は金属箔体であるＰｔ箔、１０は無機誘電体薄膜である$SrTiO_3$薄膜、１１は金属体であるＮｉ薄膜、１２はポリイミド絶縁膜、１３はＮｉ薄膜、１４は半田バンプ、８はＩＣを組み込んだ半導体素子をそれぞれ示している。

【００３３】次にこの装置の製造方法を説明する。先ず厚さ５μｍのＰｔ箔９上に$SrTiO_3$薄膜１０と第１のＮｉ薄膜１１をそれぞれ１００ｎｍ毎ＲＦマグネトロンスパッタ成膜し、ＰＥＰ工程、Ｎｉエッチング、レジスト剥離処理を経て１００μｍ角の薄膜キャパシタを形成した。

【００３４】次にこの薄膜キャパシタをダイシングして２００μｍ角に切り出して、Al_2O_3基板８上に導電ペーストで接着した後、Al_2O_3基板８上にポリイミドを塗布、露光現像処理を施してポリイミド絶縁膜１２を２０μｍ厚形成した。

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＊【００３５】次に第２のＮｉ薄膜１３を２μｍ厚蒸着し、このＮｉ薄膜１３上にＰＥＰ工程によりポリイミド絶縁膜１２と同じパターンでレジスト（図示せず）を８μｍ厚にパターン形成した。

【００３６】次に前記レジストをマスクとし、第２のＮｉ膜１３をカソード層として、めっき法により半田を積層後、前記レジストを除去し１００μｍ角、高さ３０μｍの半田バンプ１４を４個形成した。

【００３７】次にこの４個の半田バンプ１４が半導体素子１５の四隅と一致するように、半導体素子１５を配置し半田リフローにより、半導体素子１５を実装した。本実施例のように、金属箔体を用いた薄膜キャパシタは素子全体の厚みをバンプの高さに比べると充分に薄く構成できるので、バンプとパッド間に本発明による薄膜キャパシタを介在させることが可能となり高密度実装を実現できる。

【００３８】

【発明の効果】以上説明したように、本発明によれば素子全体の厚みが飛躍的に減少し、また巻き込み・折り畳みによる多層化、無機誘電体薄膜と金属体を交互に積層することによる多層化が可能であるので、小型・大容量の薄膜キャパシタを提供することができる。

【図面の簡単な説明】

【図１】　本発明による薄膜キャパシタの断面図。

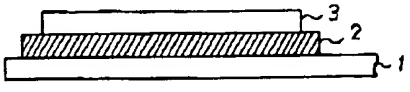
【図２】　本発明による薄膜キャパシタの製造方法を説明する断面図。

【図３】　本発明による薄膜キャパシタを半導体チップと基板間に介在して構成した装置の断面図。

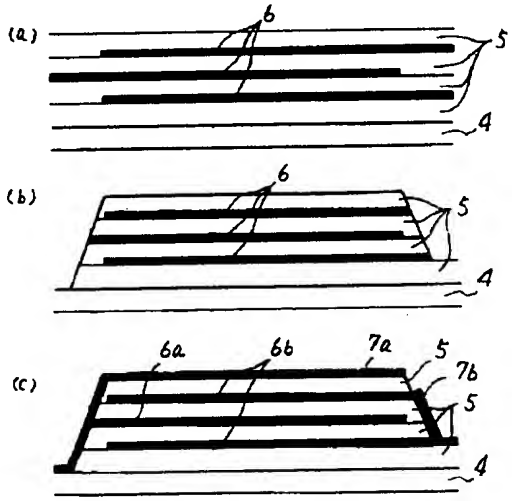
【符号の説明】

１・・・金属箔体
２・・・無機誘電体薄膜
３・・・金属体
４・・・金属箔体
５・・・無機誘電体薄膜
６・・・金属体
７・・・電極
８・・・Al_2O_3基板
９・・・金属箔体
１０・・・無機誘電体薄膜
１１・・・金属体
１２・・・ポリイミド絶縁膜
１３・・・Ｎｉ電極
１４・・・半田バンプ
＊　１５・・・半導体素子

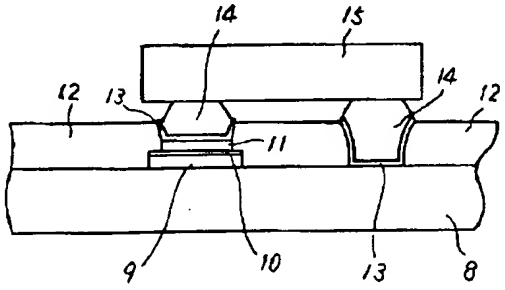
【図１】



【図２】



【図３】



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the thin film capacitor used for a multi chip module (MCM), the circuit module for mobile telecom terminals, etc.
[0002]
[Description of the Prior Art] Further miniaturization and high-density-assembly-ization of mounting technology are demanded with a miniaturization, improvement in the speed, and highly-efficient-izing of an electron device. Miniaturization and high-density-assembly-ization have been advanced also for capacitor parts, such as a decoupling capacitor for power supply stable carried in a circuit module in such a demand. Although capacitor parts had the chip conventionally in use, the thin film capacitor is examined as a method of a chip having a limitation pointed out by the miniaturization and replacing with this.
[0003] The thin film capacitor has constituted the structure where the conductive thin film which is a lower electrode, the inorganic-dielectric film, and the conductor film which is an up electrode were formed one by one on the substrate which is a base material, and the creation is usually performed by performing the membrane formation process by vacuum evaporationo, sputtering, etc., and the patterning process by PEP and etching repeatedly to each class.
[0004] As a merit to the chip of a thin film capacitor, two points of large-capacity-izing accompanying the miniaturization by sharp reduction of (1) each thickness and thin-film-izing of (2) inorganic-dielectric layers are gained. However, since the substrate which is a base material is required for thin film creation, it has a limitation also in a miniaturization and large capacity-ization for the multilayering seen by chips, such as a film capacitor, to be difficult etc. from the complexity of that thickness of the whole element cannot be made below into the thickness of a substrate, and a creation process which was mentioned above.
[0005]
[Problem(s) to be Solved by the Invention] As mentioned above, the present condition is that small [required for a miniaturization and improvement in the speed] and the mass thin film capacitor of a device are not offered. this invention is accomplished in view of the above-mentioned trouble, and it aims at offering small and a mass thin film capacitor, without complicating a process.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned trouble, the thin film capacitor by the invention in this application is characterized by providing a metallic foil object, the inorganic-dielectric thin film formed on the metallic foil object, and the metal body formed on the aforementioned inorganic-dielectric thin film.
[0007] Moreover, the thin film capacitor by this invention is characterized by being involved in or being collapsed. Thickness is the metal plate of micron order and 5-100 micrometers of board thickness of the aforementioned metallic foil object are desirable. Especially if conductivity is shown as a metallic foil object material and it is with a high material of opportunity-ductility and malleability, although it will not be limited, Pd, Au, aluminum, nickel, and Pt are desirable. moreover, SrTiO3 later mentioned as an inorganic-dielectric thin film material and BaSrTiO3 etc. -- when using oxide ceramics, especially noble metals, such as Pt, Au, and Pd, are desirable at the point of not making a resultant with a low dielectric constant to the interface of a metallic foil object and an inorganic-dielectric thin film layer
[0008] as an inorganic-dielectric thin film material -- SiO2, Ta 2O3, SrTiO3, and BaSrTiO3 although it begins and thin-film-izing is possible, and it will not be limited especially if it is -- 2 receive 2 or more figure of SiO(s), and Ta 2O3 SrTiO3 which receives and has a dielectric constant big 1 or more figures, and BaSrTiO3 etc. -- the oxidization ceramics which have a perovskite structure are more desirable in respect of large-capacity-izing
[0009] Moreover, Pt, Au, Pd, nickel, aluminum, etc. are desirable at the reason same as a metal-body material as metallic foil object material. Especially the membrane formation method of an inorganic-dielectric thin film and a metal body is not limited, but may be based on wet methods, such as anodic oxidation besides vacuum processes, such as vacuum evaporationo and sputtering, and a sol-gel method. If the forming-membranes method in which mask membrane formation is possible is used like vacuum evaporationo and sputtering, a PEP process can be cut down and facilitation of a process can be attained.
[0010] moreover -- as an inorganic-dielectric thin film -- SrTiO3 and BaSrTiO3 etc. -- since it is obtained that a film [carry / in vacuum processes, such as vacuum evaporationo and sputtering,] is more nearly quality when using the oxidization ceramics which have a perovskite structure, it is more desirable
[0011] In this invention, multilayering becomes possible as a metallic foil object by bending, such as Pt, Au, Pd, nickel, and aluminum, contamination, folding by using a strong material distorted, etc. In multilayering by contamination, folding, etc., in order to avoid the electric contact to a metallic foil object and a metal body if needed, it is effective to form the insulator on a thin film on the aforementioned metal body. Moreover, it is also effective to attain multilayering by making it the multilayer structure which carried out the laminating of the conductor thin film to the aforementioned inorganic-dielectric thin film by turns as a metal

body besides contamination and foldi

[0012]
[Function] this invention serves as the metallic foil object as the substrate which makes an inorganic-dielectric thin film form, and an electrode. the thickness of the whole element decreases by leaps and bounds by carrying out like this -- natural -- further -- contamination - collapsing -- etc. -- it becomes possible to realize the miniaturization of an element
[0013]
[Example] With reference to a drawing, the example of this invention is explained in detail below.
(Example 1) Drawing 1 is the cross section showing the outline composition of the thin film capacitor of this invention. The metal body 3 which is an up electrode is formed the inorganic-dielectric thin film 2 by which membrane formation formation was carried out on the metallic foil object 1 which serves both as the substrate and the lower electrode, and on this inorganic-dielectric thin film 2.
[0014] Next, the manufacture method of the thin film capacitor by this example is shown. The Pt foil 1 with a thickness of 10 micrometers is first prepared as a metallic foil object 1, RF magnetron sputtering system (Shibaura Engineering Works Co., Ltd. make : CFS-8EP-55SC) is used on this Pt foil 1, and it is TiO (Ba0.5 Sr0.5)3. 200nm mask membrane formation of the inorganic-dielectric thin film 2 is carried out. Membrane formation temperature at this time was made into 500 degrees C.
[0015] Next, on this inorganic-dielectric thin film 2, 100nm mask membrane formation of the nickel thin film 3 is carried out as a metal body 3 at the membrane formation temperature of 350 degrees C by RF magnetron sputtering system. Size of an up electrode was used as 1mm angle.
[0016] In this way, when the dielectric characteristics of the obtained thin film capacitor were measured, it is capacitor size 1mmx1mmx10micromt. It received, the value of electrostatic-capacity C=30nF was acquired, and the good property was acquired.
[0017] Thin film-ization of about 1/60 is attained compared with the capacitor with which this capacitor was created on Si wafer with a thermal oxidation film of for example, 0.6mm **. Since the flow of a lower electrode is obtained by pasting up the undersurface of a metallic foil substrate with a conductive paste in case this capacitor is furthermore mounted on a mother board, when it mounts by wirebonding, the number of bonding pads is one sufficient (for up electrodes). Therefore, since the space required on the outskirts is halved, it is suitable for high density assembly. Therefore, electrostatic capacity sufficient in size sufficient in this example for the miniaturization of an element can be obtained.
[0018] (Example 2) The Pt foil 1 (it ** 10 micrometers) which are four kinds of metallic foil objects 1 with which surface-finish states differ RF magnetron sputtering system is used on surface roughness Ra=1nm, 5nm, 10nm, and 20nm. It is SrTiO3 as an inorganic-dielectric thin film 2. The nickel thin film 3 (thickness of 100nm, membrane formation temperature of 350 degrees C) was formed one by one, using a mask as a thin film 2 (thickness of 100nm, membrane formation temperature of 500 degrees C), and a metal body 3. Size of an element was used as about 1mm angle.
[0019] In this way, when the dielectric characteristics of the obtained thin film capacitor were measured and the SrTiO3 thickness t filled the relation of t>=20xRa to Ra of Pt foil, leakage-current density J<=10-5 A/cm2 and the practical value of breakdown voltage Vmax.>=20V were acquired.
[0020] Also in this example, sufficient electrostatic capacity can be obtained in sufficient size for the miniaturization of an element.
(Example 3) The aluminum foil 1 with a thickness of 5 micrometers is first prepared as a metallic foil object 1, RF magnetron sputtering system is used on this aluminum foil 1, and it is SrTiO3 as an inorganic-dielectric thin film 2. The thin film 2 (thickness of 100nm, membrane formation temperature of 400 degrees C) was formed with the 1mmx100mm band-like mask.
[0021] Next, on this inorganic-dielectric thin film 2, the above-mentioned mask was used and the nickel thin film 3 (thickness of 100nm, membrane formation temperature of 350 degrees C) was formed as a metal body 3 by RF magnetron sputtering system. Next, the outgoing line (not shown) of Pt is welded to the nickel foil 1 and the nickel thin film 3, and it is SrTiO3. When the thin film 2 and the nickel thin film 3 involved in the nickel foil 1 by which the laminating was carried out centering on the shorter side (1mm length) of a band, the thin film capacitor of the shape of a pillar with a diameter [of about 1mm] and a length of 1mm was completed.
[0022] In this way, when the dielectric characteristics of the obtained thin film capacitor were measured, the mass value with an electrostatic capacity of C= 4.4 micro F was acquired to capacitor size 1mmphix1mm. the contamination type as the usual organic film capacitor with this same capacitor -- an organic dielectric -- specific inductive capacity -- 2 order size -- since the **** inorganic quantity dielectric constant thin film has realized, as compared with the organic film capacitor of the same capacity, capacitor size can be made small 2 order Therefore, electrostatic capacity sufficient in size sufficient in this example for the miniaturization of an element can be obtained.
[0023] (Example 4) The nickel foil 1 with a thickness of 5 micrometers is first prepared as a metallic foil object 1, RF magnetron sputtering system is used on this nickel foil 1, and it is SrTiO3 as an inorganic-dielectric thin film 2. The thin film 2 (thickness of 100nm, membrane formation temperature of 400 degrees C) was formed with the 1mmx50mm band-like mask.
[0024] Next, on this inorganic-dielectric thin film 2, the above-mentioned mask was used and the nickel thin film 3 (thickness of 100nm, membrane formation temperature of 350 degrees C) was formed as a metal body 3 by RF magnetron sputtering system. Next, the outgoing line (not shown) of Pt is welded to the nickel foil 1 and the nickel thin film 3, and it is SrTiO3. When the direction of the long side was made into 1mm width of face centering on the shorter side (1mm length) of a band at the winding path, the thin film capacitor with width of face of 1mm, a length [of 1mm], and a thickness of about 1mm completed the nickel foil 1 with which the laminating of a thin film 2 and the nickel thin film 3 was
[0025] In this way, when the dielectric characteristics of the obtained thin film capacitor were measured, the mass value with an electrostatic capacity of C= 1.1 micro F was acquired to capacitor size 1mmx1mmx1mm. Also in this example, sufficient electrostatic capacity can be obtained in sufficient size for the miniaturization of an element for the same reason as an example 3.
[0026] (Example 5) Drawing 2 (a), (b), and (c) are the cross sections explaining the manufacturing process of the thin film

capacitor concerning this example.

[0027] As first shown in drawing 2 (a), the Pt foil 4 with a thickness of 5 micrometers is prepared as a metallic foil object 4. RF magnetron sputtering system is used on this Pt foil 4. It is TiO3 as an inorganic-dielectric thin film 5 (Ba0.5 Sr0.5). As a thin film 5 (thickness of 200nm, membrane formation temperature of 500 degrees C), and a metal body 6, the inorganic-dielectric thin film 5 was formed for the Pt thin film 6 (thickness of 50nm, membrane formation temperature of 400 degrees C), and three layers and a total of seven layers were formed for four layers and the metal body 6 one by one, respectively. It is TiO(Ba0.5 Sr0.5) 3 in that case. Mask membrane formation of the Pt thin film 6 was carried out so that it might contact alternately, as a thin film 5 showed all over drawing.

[0028] Next, as shown in drawing 2 (b), it is TiO(Ba0.5 Sr0.5) 3 by the PEP process, the ion milling process, and the resist exfoliation process. Package taper etching of the both sides of a thin film 5 and the Pt thin film 6 was carried out. At that time, the PEP process was inserted in the middle of etching so that one side of the lowest layer of the inorganic-dielectric thin film layer 5 might remain, as shown all over drawing.

[0029] Next, as shown in drawing 2 (c), nickel electrode layers 7a and 7b were formed. Consequently, nickel electrode 7a, Pt electrode layer 6a, and the Pt foil 4 serve as structure which was contacted electrically and nickel electrode layer 7a and Pt electrode 6b contacted electrically, and the portion (inside L of drawing) with which the electrode layer has lapped through the inorganic-dielectric layer 5 serves as composition of a multilayer capacitor.

[0030] In this way, when the dielectric characteristics of the obtained thin film capacitor were measured, it is capacitor size 1mmx1mmx6micromt. It received and the value of electrostatic-capacity C=120nF was acquired.

[0031] Thin film-ization of about 1/100 is attained compared with the capacitor of this structure which created this capacitor for example, on usual Si with 0.6mm thick thermal oxidation film. Therefore, electrostatic capacity sufficient in size sufficient in this example for the miniaturization of an element can be obtained.

[0032] (Example 6) Drawing 3 is the cross section showing some power amplification modules of the mobile telecom terminal which used the thin film capacitor of this invention, and eight in drawing is aluminum 2O3. 10 is a substrate, Pt foil whose 9 is a metallic foil object, and SrTiO3 which is an inorganic-dielectric thin film. A thin film, nickel thin film whose 11 is a metal body, and 12 show the semiconductor device in which nickel thin film and 14 included the solder bump, and, as for a polyimide insulator layer and 13, 8 included IC, respectively.

[0033] Next, the manufacture method of this equipment is explained. It is SrTiO3 on the Pt foil 9 with a thickness of 5 micrometers first. RF magnetron-sputtering membrane formation of a thin film 10 and the 1st nickel thin film 11 was carried out the whole 100nm, respectively, and the thin film capacitor of 100-micrometer angle was formed through a PEP process, nickel etching, and resist exfoliation processing.

[0034] Next, the dicing of this thin film capacitor is carried out, and it starts on 200-micrometer square, and is aluminum 2O3. aluminum 2O3 after pasting up with an electric conduction paste on a substrate 8 On the substrate 8, the application and the exposure development were given for the polyimide and the polyimide insulator layer 12 was 20 micrometer-thick-formed.

[0035] Next, 2-micrometer thick vacuum evaporationo of the 2nd nickel thin film 13 was carried out, and pattern formation of the resist (not shown) was carried out to 8-micrometer ** by the same pattern as the polyimide insulator layer 12 according to the PEP process on this nickel thin film 13.

[0036] Next, the aforementioned resist was used as the mask, after a laminating and the aforementioned resist were removed for solder by the galvanizing method by having used the 2nd nickel film 13 as the cathode layer, and 100-micrometer angle and the solder bump 14 with a height of 30 micrometers were formed four pieces.

[0037] Next, the semiconductor device 15 has been arranged and the semiconductor device 15 was mounted by the solder reflow so that this four solder bump 14 might be in agreement with the four corners of a semiconductor device 15. Like this example, since the thin film capacitor using the metallic foil object can constitute the thickness of the whole element thinly enough compared with a bump's height, it becomes possible to make the thin film capacitor by this invention intervene between pads with a bump, and high density assembly can be realized.

[0038]

[Effect of the Invention] Since the multilayering by the thickness of the whole element decreasing by leaps and bounds, and carrying out the laminating of the metal body to the multilayering by contamination and folding and an inorganic-dielectric thin film by turns is possible according to this invention as explained above, small and a mass thin film capacitor can be offered.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The cross section of the thin film capacitor by this invention.
[Drawing 2] The cross section explaining the manufacture method of the thin film capacitor by this invention.
[Drawing 3] The cross section of the equipment which intervened between the semiconductor chip and the substrate and constituted the thin film capacitor by this invention.
[Description of Notations]
1 ... Metallic foil object
2 ... Inorganic-dielectric thin film
3 ... Metal body
4 ... Metallic foil object
5 ... Inorganic-dielectric thin film
6 ... Metal body
7 ... Electrode
8 ... aluminum 2O3 Substrate
9 ... Metallic foil object
10 ... Inorganic-dielectric thin film
11 ... Metal body
12 ... Polyimide insulator layer
13 ... nickel electrode
14 ... Solder bump
15 ... Semiconductor device

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The thin film capacitor characterized by providing a metallic foil object, the inorganic-dielectric thin film formed on the metallic foil object, and the metal body formed on the aforementioned inorganic-dielectric thin film.
[Claim 2] The thin film capacitor according to claim 1 characterized by carrying out at least one or more layer laminating membrane formation of an inorganic-dielectric thin film and the metal body, and involving in this metallic foil object on the aforementioned metallic foil object, or being folded up.

[Translation done.]